**Kinematics Summary Sheet**

|  |  |  |  |
| --- | --- | --- | --- |
| **Displacement, Speed, Velocity, Acceleration** | | | |
| **Displacement** – change in position   1. Vector, units = length (m) 2. Δ**x** = **x** – **x**0   **Speed** – total distance traveled in a given time   1. Scalar, units = length/time (m/s) 2. Ave Speed = (total distance)/(total time)   **Velocity** – rate at which a position changes   1. Vector, units = length/time (m/s) 2. **V**ave = (Δ**x**)/(Δt)   **Acceleration** – rate at which velocity changes   1. Vector, units = length/time2 (m/s2) 2. **a** = Δ**v**/Δt 3. Negative acceleration – acceleration in the negative direction. 4. Deceleration – Acceleration opposes the velocity vector | | |  |
| **1-D, 2-D Kinematic Equations of Motion: Only valid for constant acceleration** | | | |
| 1. Write down the five variables and the appropriate values for each. Look at the problem statement for clues. 2. In most cases, you must know the values for three of the variables. 3. Select the correct equation by identifying which equation has only one unknown and solve for the unknown. 4. For 2D problems, treat x and y independently and use the same kinematic equations. | | | |
| **Free Fall** | | | |
| 1. Any object that falls to the earth is in free fall 2. Objects in free-fall experience the constant acceleration of gravity (9.81 m/s2 down) 3. The acceleration of gravity is given the symbol "g" and has units L/T2 (m/s2) 4. Acceleration due to gravity can be represented as a vector and always points towards the center of the earth 5. Because g is a constant acceleration, we can use our constant acceleration kinematic equations for all free-fall problems | | | **Solving Free-Fall problems**   1. Acceleration is always 9.8 m/s2 down 2. Use the constant acceleration kinematic equations (index card) 3. Identify the five variables and the appropriate values for each. 4. At maximum height, velocity is zero, accel is still 9.8 m/s2 down. |
| **Projectile Motion** | | | |
| 1. Draw a picture of the problem. Use a standard x-y coordinate system. 2. In general, there will be an initial velocity in both the x and y directions. 3. Determine the x and y components of the initial velocity. V0x = V0(cosθ), V0y = V0(sinθ) 4. ax = 0 and Vx does not change 5. ay = -9.8 m/s2 and does not change 6. At ymax, Vy = 0, but Vx is not zero. | |  | |
| **Graphical Analysis – determine motion characteristics from plots** | | | |
| **Displacement vs Time Plot**   1. Slope of curve = velocity    1. Slope > 0, positive velocity    2. Slope = 0, zero velocity    3. Slope < 0, negative velocity 2. For constant velocity, curve is a straight line. 3. For constant acceleration, the curve is quadratic – parabola shaped. | Constant Acceleration  Constant Velocity | | |
| **Velocity vs Time Plot**   1. Slope of curve = acceleration 2. A flat curve means acceleration = zero 3. Straight line means constant acceleration    1. Slope > 0, positive acceleration    2. Slope = 0, zero acceleration    3. Slope < 0, negative acceleration | Constant Acceleration | | |